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THE INTEGRATION OF BEEF CATTLE FARMING SYSTEM ON THE FARM HOUSEHOLD IN MERAPI VOLCANIC SLOPE, SLEMAN YOGYAKARTA

(The Application of Linear Programming Analysis Model Toward Sustainable Livestock Development)

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ABSTRACT

The objective of the research was to investigate the optimum resources allocation of farm household to get maximum benefit. A survey was conducted using 50 respondents of beef cattle farmer taken by purposive quota sampling. The data consisted of land and beef cattle ownership, family labor, capital, input output coefficient of crop and beef cattle farming system, off farm opportunities, household consumption pattern. The data were analyzed using linear programming model. The result of the optimum solution showed that the activities with optimum use of resources were : (1) raising 2.67 animal unit of local breed, (2) cultivating 0.47 ha of land consisting of 0.25 hectare multiple cropping of *Albusia sp.* and hybrid grass, and 0.22 ha single cropping of cloves. The optimal allocation of the farm household resources could increase the farm income as much as 85 %. That increase was gained by selling heifer and steer on its optimum age; selling crop production in the optimum pattern; making use of by-product of cattle feed and manure for crop fertilizer; and using optimum family labor. The application of linear programming model could identify the interrelationships among many activities in farm household toward sustainable beef cattle farming system

Key word : Beef Cattle, Farming System, Farm Household, Linear Programming

INTODUCTION

More than 90% of beef cattle in Indonesia are kept by farmer in a small scale, 2-4 heads per farmer in a farming system (Statistical on livestock, 2005). Indonesian's farmers, especially in Java only have less than 0.5 ha arable land. There fore mix farming system, in which crops and livestock are integrated constitute a back bone of small scale production in Java, including Yogyakarta. That condition has also occurred in many other developing countries, such as in sub Saharan Africa and many of Asia (Lenne and Thomas, 2005).

Amir and Knipscheer (1989) explained that a farming system is a conceptual artifice that includes a collection of interdependent and interactive elements or resources that act together to accomplish a given task. It also means that the farm household will use resources optimally to meet the food and other basic family needs. According to Barker and Chapman (1999) the meaning of sustainable development in the economics implies a stable and satisfactory relationship between agricultural production and consumption. It implies growth rate that is supportable on a long term basis.

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The resources management for livestock development has been needed, because there are many constraints that are faced by farmers. Livestock development management depend on the feed supply that is produced from their own land, the environmental biophysics condition and the cultural society (Orskov,2002). Many kinds of resources constraints that are caused by physical area condition and the deference of agro-ecological zones have potential to greatly influence animal agricultural production system. Indonesia has various areas which have very complex physical condition. Studying the behavior of resources allocation in farming system is needed to find several alternatives toward sustainable beef cattle farming development.

MATERIALS AND METHODS

Reasearch frame work

The research frame work used Agricultural Household Models Approach (Singh et al.,1986). It was based on the assumption that farm household played role as a producer as well as a consumer. As a consumer they will maximize utility to meet the household needs. To achieve the utility they faced the cash income constraint. Meanwhile as a producer farmers will maximize their income, they faced many constrains such as, (1) low land ownership (2) low available family labor, (3) capital and technology constraint that can influence the productivity. Agricultural sustainability requires sufficient equity in access to production capacity and distribution to ensure the consumption in long term. One of many analysis tools that can overcome the problem of resources constraint to maximize certain objective function is Linear Programming (LP) model (Beneke and Winterboor, 1973 ; Doll and Orazem, 1978).

Method and Analysis

The location of the research was Cangkringan district, Sleman regency, Yogyakarta. Two village were determined as the sample location that is based on the density of beef cattle population. The respondent was household of beef cattle farmer in research location that taken by purposive quota sampling. The number of respondents for each village is 25 households.

The research used survey method by doing indebt interview to respondent using questionnaire. The respondents should accomplish the condition that they have kept minimum one cow for one year. Such condition was needed to get the information of technical coefficient and input-output coefficient of beef cattle farming. The secondary data was taken from related institutions.

Based on the frame work, LP model is one of the normative analysis tool that is used in this research. LP is used to arrange the farm household enterprises planning according to well-defined practices in accordance with household goals, preference and resources constrain. Normatively the solution of LP analysis will lead into the guidance, if the following points have been determined : (1) Objective, (2) constraints, (3) many alternatives of activity to achieve the goal. (Beneke and Winterboer, 1973 ; Doll and Orazem, 1978).

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LP model in this research can be determined mathematically as the following :

Maximize :

$$Z = - \sum_{i=1}^{9} \sum_{j=1}^{n} C_{ij} X_{ij} + \sum_{i=1}^{9} \sum_{k=1}^{m} C_{ik} X_{ik}$$

Subject to :

(1). a_{ij} and a_{ik} $\leq b_{iq}$

(3). $- Y_{i(j+1)k} + 1 \leq 0$

$1 = Y_{i(j+1)k}$)

(4). $X_{ijk} \geq 0$

Where :

Z = Return to farm household income = Gross income – farm household expenses

C ij = the price of purchased input for production activity (crop, animal and off farm opportunities) at j, in the **i** time period

Xij = production activity at j, in the i time period

Cik = price of output (product) k in the i time period.

Xik = consumption and marketing activities of output k, in the i time period.

a_{ij} = input-output coefficient of production activity at j, in the i time period

a_{ik} = input-output coefficient of consumption and marketing activity of output k, in the i time period .

b_{iq} = constrain or supply of resources q which can be used to activity j and/or k in the i time period (q = 1,2,3 ..... s)

Yi(j+1) k = the output transfer row from production activity j which is used for the activity j+1 or sold as a product k, in the i time period.

i = 1,2,3 ..... 9 (this model covered 3 years time period, in one year divided for 4 months, so in that all time period was 9 periods).

The constraint of the output transfer row enable to link between an activity to another. The crop production activity yields main product that can be self consumed or sold and by-products for cattle feed, if there are less than the yield it can be linked by buying activity of animal feed but which is constrained by their own capital. In the same way in beef cattle production activity. The LP analysis model can give optimal solution or optimally resource allocation that appropriate to the responds of the constrains, so it can be used as a concept toward of sustainable agriculture development

The following assumptions were used :

1. The assumptions of the model refered by Beneke and Winterboor, (1973) dan Doll and Orazem, (1978).
2. Operational assumption of this research :
   a. Time periods of analysis were 3 years. This period refered the life cycle of cows, which can be expected to produce a calf, steer or heifer. One year divided into 3 periods based on the difficulty to collect feed by farmer.

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b. By-products that are yielded by every kinds of crops to cattle feed are converted in Total Digestible Nutrition for cattle following Hartadi, et al. (1986), in the same way of cattle feed requirement based on TDN following National Research Council (1984).
c. The amount of credit investment and the level of interest rate which can be loaned according to government rules.
d. The condition of crop and beef cattle farming and off farm job opportunities during 3 years period are assumed similar to the moment that the research has been done.

The optimal solution has been done using the BLPx88 program.

RESULTS AND DISCUSSION

The location of the research was an upland or dry land area located in southern slope of merapi mountain, Sleman Yogyakarta. It was the recharge area with annual crops as the dominant cropping system, such as the following :

1. Multiple cropping *Albasia, Sp.* and hybrid grass (king grass).
2. Single cropping Clove and growing natural grass under the main crop that can be used to support the animal feed,
3. Single cropping Coffee and growing natural grass under the main crop that can be used to support the animal feed,
4. Single cropping hybrid grass (king grass), usually only be cultivated in a little part of their own land.

The main product of that cropping system were woods, clove, and coffee. Meanwhile the crops by-product such as the leaf of *Albasia Sp.*, natural grass, others wild crop and hybrid grass were used as cattle feed. Then the farmers used manure from the cattle to fertilize their land, without the manure the annual crop can not thrive. There were two kind of cattle breeds, the local and the hybrid cross. The local breed was ongole cross and the crossbred cattle was Simmental.

Animal feed consists of roughage and concentrate. Most of roughage was from crops residue. If there was an insufficiency, the farmers would gather grass from the open space. They only purchased a few especially in the end of dry season. All of the concentrate feed was purchased by farmers from the market around their neighborhood. They set the purchase right to their current cash. Most of them did not do the purchase appropriately due to the animal feed requirement. Generally the respondents needed more feed for hybrid cross than for the local cross. They used artificial insemination to manage the animal reproduction. The average of calving interval was 17,17 months of local breed and 16.72 months for hybrid cross.

They have met their family needs from selling the crop product, animal product and the off farm job. They sold the steer or heifer in the age of around 6-7 months. Seventy two percent of respondents had off farm job opportunities such as workers, miners of sand and stone, merchandisers and few of them work for the government as civil servant. The off farm depended on the opportunity and the family labor availability. The chance for off farm job opportunities was 42.17 man days (MD) per season or 126,51 MD per years (1 MD is one person working 7-8 hours per day). The average of the cash income was Rp 15,470.00 per MD. When the research was done in

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Tabel 1. Return to farm household income in optimal solution vs. existing condition

Income of :	Average per years (Rp 000)	Increasing of optimal solution vs existing condition (%)
Existing Condition	4,259,034.00	85,76 %
Optimal Solution	7,911,720.00	

Footnote : Primary data in 2000
Exchange rate on 2000 was $ 1 = Rp 8,000.00, in 2006 was Rp 9,000.00

Tabel 2. Optimum allocation of farm household resources

Activity	Activities of optimal solution	Unit of activity	Total of resources
Crop farming	Multi cropping Albasia,Sp.-king grass	0.21 ha	
	Single cropping clove	0.22 ha	0.47 ha
	King grass	0.04 ha	
Beef cattle farming	Local breed cow	1.74 AU	
	Selling heifer/steer in the optimum age (18 months)	0.93 AU	2.67 AU
Allocation of family labor		Min-max/season	
	On Farm activities	100 – 153 MD	
	Off farm activities	30 – 42 MD	130 – 195 MD
Preparation of the capital	Credit of operational capital (interest rate 10.5%)	Rp 330 000.00	Rp 5 530 000.00
	Self fixed capital	Rp 5 200 000.00 *)	

Footnote : The self fixed capital was used to purchase the local breed cow as much as 1.74 AU
1 Animal Unit (AU) = 1 cow, Calf less than 4 months = 0.15 AU, calf around 4 -8 months =
0.4 AU, heifer or steer around 8-12 months = 0.6 AU, 12-18 months = 0.8 AU and > 18 months = 1 AU.

the year 2000, the price of the rice was around Rp 2300.00 per kg. while current price of rice is Rp 3800.00

The result of the optimal solution from the LP analysis were presented in table 1 and table 2.

The condition small holder of beef cattle can be improved through the management of resources allocation by integrating activities in household farming system in accordance with the environment condition. Beef cattle farming sustainability in the research area can be maintained by cultivating 0.47 ha with optimum crop pattern and raising maximum 2.76 AU local breed.

CONCLUSION

The resources optimal allocation would increase the existing income as much as 85.76%. The increase was gained by selling beef cattle production (steer or heifer) in the optimal age, selling crop production in the optimum pattern, using by-product of cattle feed and manure for crop fertilizer, using optimum family labor and capital. The application of linear programming model could identify the interrelationships among many activities in farm household toward sustainable beef cattle farming system.

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